DOCUMENT RESUME

ED 376 040 SE 054 740

AUTHOR Bailey, Paul

TITLE The Old New River. New River State Park: An Environmental Education Learning Experience Designed for Grades 7 & 8.

INSTITUTION North Carolina State Dept. of Environment, Health, and Natural Resources, Raleigh. Div. of Parks and Recreation.

PUB DATE Mar 94
NOTE 57p.; For related guides, see SE 054 736-744 and SE 054 746.
AVAILABLE FROM North Carolina Division of Parks and Recreation, P.O. Box 27687, Raleigh, NC 27611-7687.
PUB TYPE Guides - Classroom Use - Instructional Materials (For Learner) (051) -- Guides - Classroom Use - Teaching Guides (For Teacher) (052)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Classification; Environmental Education; Grade 7; Grade 8; Junior High Schools; *Parks; *Resource Allocation; Science Activities; Science Education; *Water Quality
IDENTIFIERS Aquatic Life; *Aquatic Organisms; Environmental Awareness; Hands On Experience; Leaves (Trees); Metamorphosis; North Carolina State Parks System; *Stewardship; Water Quality Analysis; Watersheds

ABSTRACT

This activity guide, developed to provide hands-on environmental education activities geared to New River State Park in North Carolina, is targeted for grades 7 and 8 and meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included: pre-visit, on-site, and post-visit. The on-site activity is conducted at the park, while pre- and post-visit activities are designed for the classroom. Major concepts included are: water quality, biotic index, indicator species, metamorphosis, native aquatic species, stewardship of natural resources, watersheds, and natural resource management. Includes a vocabulary list, scheduling worksheet, parental permission form, North Carolina Parks and Recreation program evaluation, and information about New River State Park. (MKR)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 376 040

THE OLD NEW RIVER

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

J.B. Hallsey

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

New River State Park

An Environmental Education Learning Experience

Designed for Grades 7 & 8

BEST COPY AVAILABLE

"The care of the River
is not a question of rivers,
but of the human heart."

- Tanaka Shozo

"We are born of water and
need to be sustained by it."

- Lyall Watson,
The Water Plant,
A Celebration of the Wonder of Water

Funding for this publication was generously provided by

CP&L

This Environmental Education Learning Experience
was developed by

Paul Bailey
Lead Interpretation and Education Ranger
New River State Park

N.C. Division of Parks and Recreation
Department of Environment, Health and Natural Resources

DEHNR

James B. Hunt, Jr.
Governor

Jonathan B. Howes
Secretary

Other Contributors . . .

Park volunteers;

The N.C. Department of Public Instruction;

The N.C. Division of Water Resources;

The N.C. Department of Environment, Health
and Natural Resources;

and the many individuals and agencies who assisted
in the review of this publication.

500 copies of this public document
were printed at a cost of
$1,750 or $3.50 per copy

Printed on recycled paper.
3-94

Table of Contents

1. Introduction
- Introduction to the North Carolina State Parks System 1.1
- Introduction to New River State Park 1.2
- Introduction to the Activity Packet for New River State Park 1.6

2. Activity Summary 2.1

3. Pre-Visit Activity
- #1 Keys to Knowledge 3.1

4. On-Site Activity
- #1 Life in the Fast Stream 4.1
  - Part I - What's In the Water? 4.1.2
  - Part II - Calculating Water Flow of the New River 4.1.10

5. Post-Visit Activity
- #1 Judge and Jury 5.1

6. Vocabulary 6.1

7. References 7.1

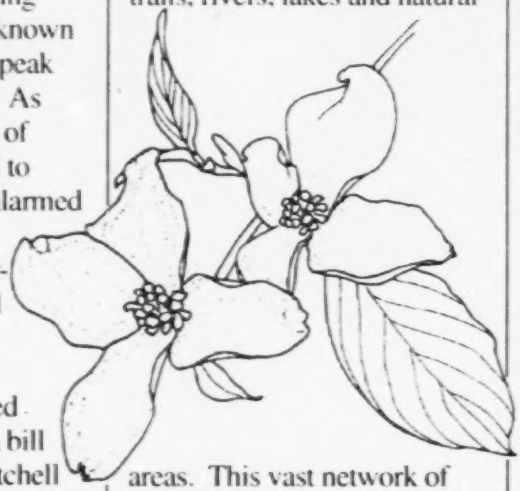
8. Forms 8.1

9. Notes 9.1

Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first park of North Carolina. That was in 1915.

The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.



As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

N.C. Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181

Introduction to New River State Park

The New River is believed to be one of the oldest rivers in the world–flowing before the Appalachian Mountains were formed. Its meandering nature is typical of a river on relatively flat land. While the area was being uplifted during the formation of the Appalachian Mountains, the river had enough force to cut down into the earth, staying in its original river bed. Some of the rocks in the river's bed are over 1.1 billion years old.

The New River begins in the Boone/Blowing Rock area, flowing northward through North Carolina, Virginia and West Virginia. In West Virginia, the New joins the Gauley River to form the Kanawha River. The Kanawha flows into the Ohio River which then flows into the Mississippi River.

The New River is home to some unique animal life. The Kanawha darter, Kanawha minnow and a species of riffle beetle are found only in the New River. The hellbender, an unusually large salamander which can grow to 30 inches in length, is also found in the river. Despite its fierce sounding name, its size and folklore that it is poisonous, this creature is harmless. More common animals found in or along the banks include ducks, beavers, turkeys, deer, ospreys, groundhogs, foxes and muskrats.

Numerous species of trees and wildflowers grow along the wooded banks of the river. Occasionally American chestnut sprouts can be found, but white pines, hickory and oaks are the most common trees.

The New River area of northwest North Carolina and southwest Virginia was being used as a hunting ground by Native Americans when the first European settlers arrived in the late 1600's. These early settlers were from Virginia. They established an independent and isolated way of life, farming the mountain valleys. Many of the farms in the area have been in the same family for over 200 years.

In 1962, the Appalachian Power Company applied to the Federal Power Commission to build two dams on the river. The dams would have flooded 42,100 acres in Virginia and North Carolina and would have forced over 2,500 people to move.

This plan was opposed by many of the area's farmers and land owners. Opposition grew into a national movement. Through a long period of nationwide publicity and legal battles, a bill to federally protect the river emerged.

On August 30, 1976 President Ford signed the bill which placed 26.5 miles of the New River into the National Wild and Scenic River System and thus ended the threat of the river being dammed.

The National Wild and Scenic River system was designed to protect the natural and scenic values of free flowing rivers while providing the opportunity and facilities for public use and enjoyment of those waterways.

The required criteria for Wild and Scenic River designation are that the river must:

- be free flowing;
- be long enough to provide a meaningful recreational experience;
- have a sufficient volume of water to permit full enjoyment of water-related activities;
- have a high water quality to support fish and wildlife.

It must also have one of the following characteristics rated as outstandingly remarkable:

- scenic;
- recreational;
- geologic;
- fish and wildlife;
- historic;
- cultural, or other similar values.

New River State Park protects over 1,100 acres along the river, including three park access sites. These sites provide public access to the river, as well as camping, picnicking, fishing and nature study. The Wagoner Road Access is off Highway 88. The U.S. 221 Access is off of Highway 221 North. The Alleghany County Access is accessible only by canoe at this time.

The river has been recognized for its outstanding water quality. Many of the animals that make their home in the river need the high quality water to survive. Development, pesticides and water withdrawal could threaten the river's quality. By being familiar with the causes and effects of water degradation, we can find ways to reduce and remove these threats.

The Park as an Outdoor Classroom

New River State Park abounds with natural history and is an excellent place to teach ecology, environmental issues, biology, conservation, earth science, literature, math and recreation. The park is rich with cultural resources and provides a wonderful outdoor classroom for learning about the history of the New River, water quality, endangered species and many other themes. Here is an opportunity for students to study and learn about these and many other subjects on a hands-on basis.

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, nature study and other activities. Leaders may choose to design and conduct their own activities or make use of the park's environmental education activity packets. A park ranger will be happy to meet with your group upon arrival to answer any questions the students may have, or welcome the group and present a short talk. Park staff will make every effort to accommodate persons with disabilities. Please contact the park office at least two weeks in advance to make arrangements for a class visit.

Park Facilities

Picnic Areas

At the Wagoner Road Access area there are two picnic areas with 20 picnic tables. There is also a picnic shelter which may be reserved for a fee. There are 12 tables located at the U.S. 221 Access. There are three picnic tables at the Alleghany County Access, however this site is accessible only by canoe.

Camping

At the Wagoner Road Access area there are nine primitive sites, located 200 yards down river from the parking lot. There are nine primitive campsites located at the U.S. 221 Access. The Alleghany County Access has eight canoe-in only campsites.

Playfield

At the Wagoner Road Access area a large open area, suitable for many play activities, is located below the parking area. (No horseshoes; contact a ranger for appropriate activities.)

Restrooms

Restrooms with running water and wheel chair accessibility are available at the park office located at the Wagoner Road Access area. Pit toilets are available at the U.S. 221 and Alleghany County Accesses.

Nature Trail

There is a self-guided nature trail at the Wagoner Road Access area.

Before the Trip

1. To make a reservation, contact the park at least two weeks in advance.

2. Complete the Scheduling Worksheet, located on page 8.1, and return it to the park as soon as possible.

3. Group coordinators should visit the park without the participants prior to the group trip. This will enable you to become familiar with the facilities, park staff, identify themes and work out any potential problems.

4. Group coordinators should discuss park rules and behavior expectations with adult leaders and participants. Safety should be stressed.

5. The group leader is responsible for parental permission forms. An example is located on page 8.2.

6. The group leader should be aware of the group's medical and health needs.

7. *If you will be late or need to cancel your trip, notify the park immediately.*

8. Research Activity Permits may be required for activities in which samples are to be taken from the park. Contact the park to determine if research activity permits are needed.

9. Complete the pre-visit activity in the Environmental Education Learning Experience packet.

Introduction to the Activity Packet for New River State Park

The Environmental Education Learning Experience *The Old New River* was developed to provide environmental education through a series of hands-on activities geared to New River State Park. This activity packet, designed for the 7th and 8th grades, meets established curriculum objectives of the North Carolina Department of Public Instruction. The packet includes three types of activities:

1) pre-visit activity
2) on-site activity
3) post-visit activity

The on-site activity will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom.

The pre-visit activity should be completed prior to the park visit to prepare students for the on-site activity, giving them the necessary introductory background and vocabulary. We encourage you to use the post-visit activity to reinforce concepts, skills and vocabulary learned in the pre-visit and on-site activities. Though these activities may be performed independently, we encourage you to do them in a series to build upon the students newly gained knowledge and experience.

The Environmental Education Learning Experience *The Old New River* will acquaint students with the following major concepts:

- **Water quality**
- **Biotic index**
- **Indicator species**
- **Metamorphosis**
- **Native aquatic species**
- **Stewardship of natural resources**
- **Watersheds**
- **Natural resource management**

The first time a vocabulary word is used in an activity it appears in **bold** type. Its definition is listed in the back of the activity packet. A list of the reference materials used in developing the activities follows the vocabulary list.

This document was designed to be reproduced, in part or entirety, for use in North Carolina classrooms. If you wish to photocopy or adapt it for other uses, please credit the N. C. Division of Parks and Recreation.

NOTE: On-site activities, conditions permitting, will be held on the banks of and in the river. Students will be expected to wade in shallow rocky areas. They should dress appropriately (long pants and tennis shoes) and bring a change of clothes. The students may encounter ticks, poison ivy and snakes. This is not likely to happen as long as they stay in appropriate areas.

While at the Park

1. Complete the on-site activity in the Environmental Education Learning Experience packet.

2. When hiking and studying at New River State Park, please be safety conscious. Some sections of the park's trails are fairly strenuous. Proper footwear should be worn and water should be carried. Also, hazards such as bees, snakes, ticks, poison ivy and extreme weather conditions exist. These hazards can cause problems if you are not prepared. Students with any medical conditions should be monitored closely by the adult leaders.

3. Be as quiet as possible while in the park. This will help you get the most out of the experience, while increasing the chance of observing wildlife.

4. On hikes, walk behind the leader at all times. Running is not permitted. Please stay on the trails!

5. All plants and animals are protected within the park. Injuring or removing plants or animals is prohibited in all state parks. Removal of rocks is also prohibited. This allows future visitors the same opportunity to enjoy our natural resources.

6. Picnic only in the designated picnic areas. Help keep the park clean and natural by not littering and by picking up any trash left behind by others.

7. In case of accidents or emergencies, contact the park staff immediately.

Following the Trip

1. Complete the post-visit activity in the Environmental Education Learning Experience packet.

2. Build upon the field ex-perience and encourage parti-cipants to seek answers to questions and problems encountered while at the park.

3. Relate the experience to classroom activities through reports, projects, demonstrations, displays and presentations.

4. Give tests or evaluations, if appropriate, to determine if students have gained the desired information from the experience.

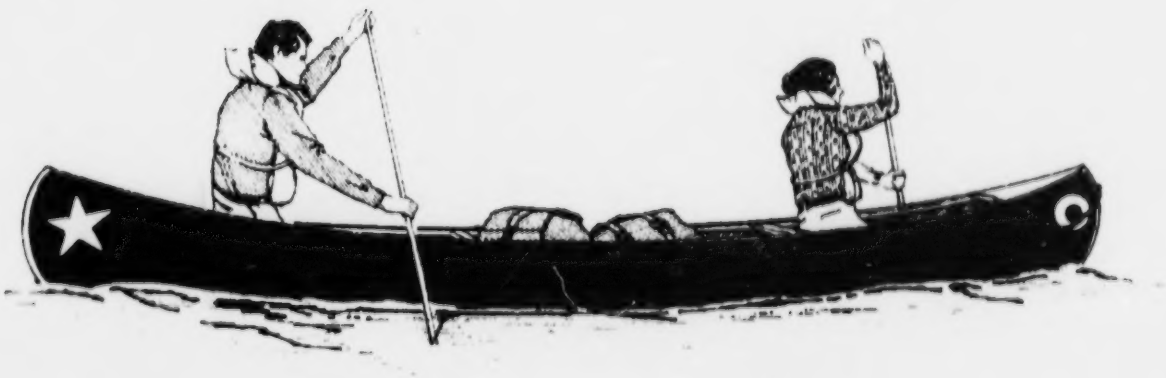
5. Please complete the program evaluation sheet, located on page 8.3, and send it to the park.

Park Information

New River State Park
P.O. Box 48
Jefferson, NC 28640
Tel: 910-982-2587

Hours of Operation

Nov - Feb	8:00 a.m. - 6:00 p.m.
Mar, Oct	8:00 a.m. - 7:00 p.m.
Apr,May,Sep	8:00 a.m. - 8:00 p.m.
Jun - Aug	8:00 a.m. - 9:00 p.m.



Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activity

#1 The Keys To Knowledge (page 3.1.1)

Introduce your students to the use of dichotomous identification keys through a series of fun activities. In Part 1, students will use a simple key to identify unknown tree leaves. In Part 2, the students will use a more complex key to identify macroinvertebrates found in the New River.

Major concepts:

Part I

- Dichotomous key
- How to use a key
- Importance of keys for identification

Part II

- Basic taxonomy

Objectives:

Part I

- Define dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.

Part II

- Define taxonomy.
- Key out at least one macroinvertebrate using a simple key.

II. On-Site Activity

#1 Life in the Fast Stream (page 4.1.1)

Get wet, have fun, and learn while doing it. In Part 1, "What's In the Water?" students will use different methods to collect and identify aquatic organisms. In Part 2, "Calculating Water Flow of the New River," students will learn a simple method for determining water flow and use this information to explore the ways that human and natural factors affect water flow and water quality. They will also be asked to think of ways they can influence local government to protect water quality.

Major Concepts:

Part I

- Water quality
- Aquatic sampling
- Indicator species
- Aquatic habitats
- Species identification
- Biotic index
- Human influence on water quality

Part II
- Water flow
- Human influences on water flow and aquatic life
- Natural influences on water flow and aquatic life
- Water quality
- Stewardship

Objectives

Part I
- Describe three characteristics of an aquatic macroinvertebrate.
- Key out five macroinvertebrates.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Calculate the biotic index.
- List three or more ways humans affect aquatic life.

Part II
- Calculate the rate of water flow.
- List three human actions and three natural influences on water flow.
- Explain the relationship between water quantity and quality.
- Describe three problems that can result from water quantity extremes and three from water quality changes.
- Discuss two ways people can help protect rivers and water quality.

III. Post-Visit Activity

#1 Judge and Jury (page 5.1.1)

In this role play activity, the students will learn about land use conflicts and stewardship.

Major concepts:
- Stewardship
- Cultural conflicts
- Land use changes

Objectives:
- Present rational points in a debate over land use.
- List three reasons for preserving and protecting the river corridor.
- List three reasons for developing all or part of the river corridor.

Pre-Visit Activity #1 — The Keys To Knowledge

Curriculum Objectives:
Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: being responsible in a group, develop an awareness of alternative points of view
- Science: scope of life science, organization and variety of living things, plant and animal communities
- Social Studies: evaluate, organize and analyze information, draw conclusions

Grade 8
- Communications Skills: listening, viewing, reading and vocabulary comprehension, study skills using environmental sources
- Science: adaptation, ecology
- Social Studies: evaluate, organize, and analyze information, draw conclusions

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
Part I: 20 - 30 minutes
Part II: 30 - 50 minutes

Appropriate Season: Any

Materials:
Provided by educator:
Per student: "Key it Out" worksheet, "Key to 10 Common Leaves," pencil
Per group: "Key to Aquatic Macroinvertebrates of the New River," "Aquatic Life" illustrations, ruler

Major Concepts:
Part I
- Dichotomous key
- How to use a key
- Importance of keys for identification

Part II
- Basic taxonomy

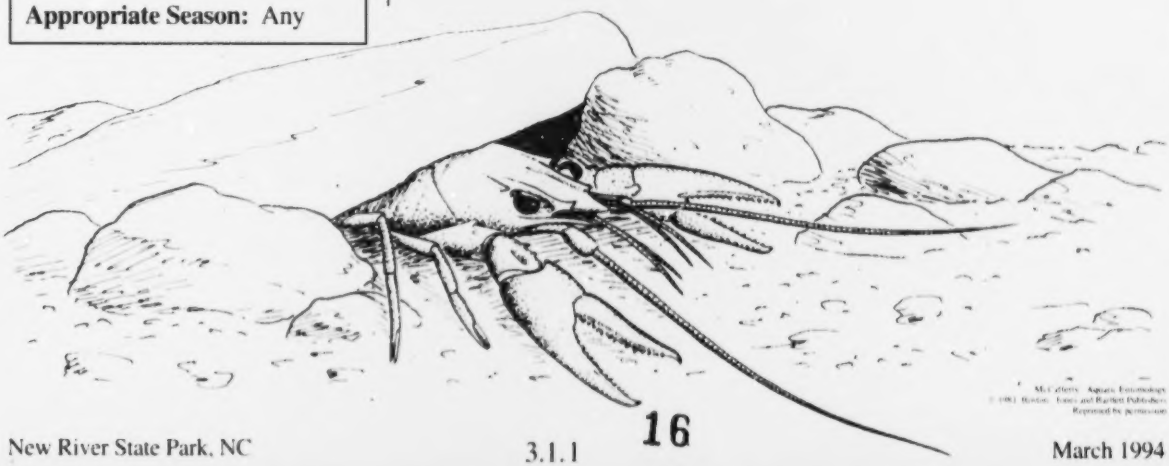
Objectives:
Part I
- Define a dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.

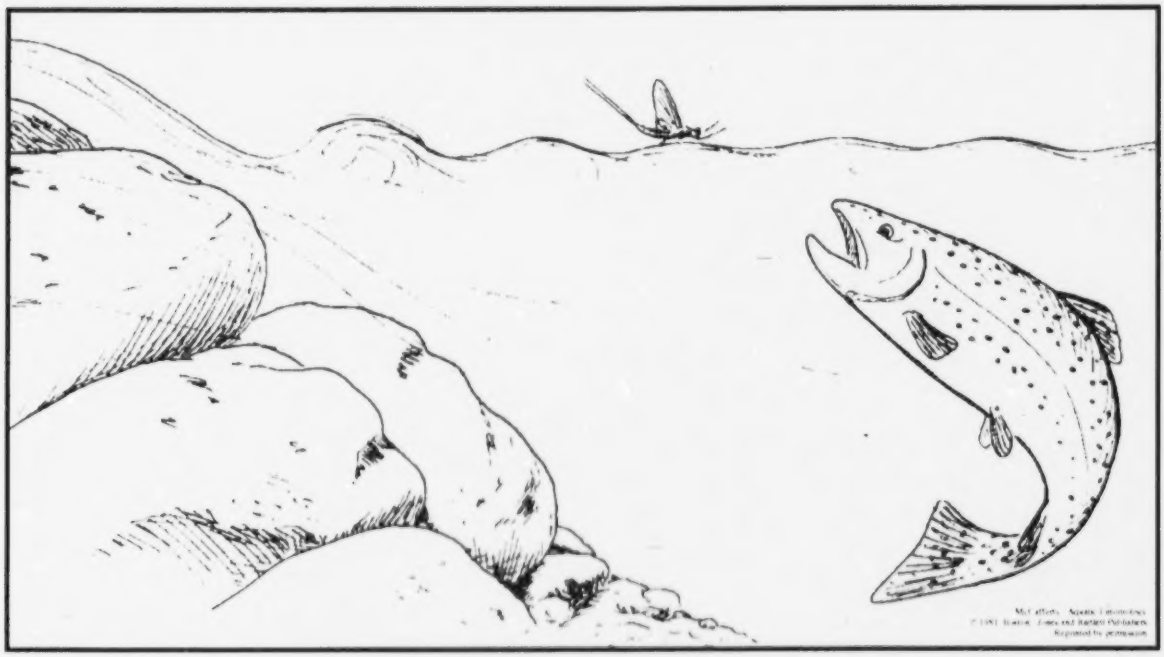
Part II
- Define taxonomy.
- Key out at least one macroinvertebrate using a simple key.

Educator's Information

The purpose of this two-part activity is to introduce the use of a simple dichotomous identification key. Students will learn what a dichotomous key is, why keys are useful and how to use a simple identification key.

Part I will give students an introduction to the use of a simple tree identification key. In Part II, the students will key out several macroinvertebrates using the same key they will use in the on-site activity "Life in the Fast Stream."





Instructions for Part I:

Have the students read the Student's Information. Discuss taxonomy and how organisms are divided into naturally related groups. Define a key and explain how keys work. Discuss why keys are useful. Give each student a copy of the "Key to 10 Common Leaves." Have students work independently through this key to identify each of the 10 leaves. As a class, go over the answers and discuss any difficulties encountered.

Instructions for Part II:

Divide the class into groups of four or five. Give each group a copy of the "**Aquatic** Life" illustrations and a copy of "Key To Common **Macroinvertebrates** of the New River." As a class, work through the key to identify animal number 1, then have the students work within their groups to identify the rest of the macroinvertebrates. When the groups are finished, have each group share how they identified one of their macroinvertebrates. Discuss any difficulties encountered and reinforce the importance of keys.

Suggested Extensions:

1. Divide the class into six groups and give each group a picture of a macroinvertebrate. Instruct each group to identify their organism. Have each group share with the class how the organism was identified.
2. Have the students do the Aquatic Project WILD activity "Are You Me?" For more information, contact the park staff.
3. Have students create macroinvertebrate "flash cards" from the Aquatic WILD activity "Are You Me?" to learn identification.

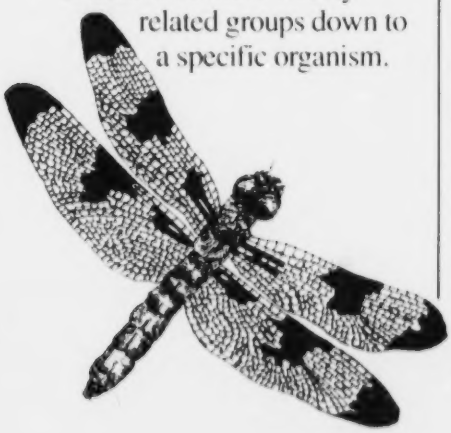
Student's Information

To understand why **keys** are necessary, we need to know some basics about **taxonomy**. Taxonomy is the branch of **biology** that deals with the **classification** of **organisms** into established categories. The word taxonomy comes from the Greek words mean-ing "arrangement" and "law". Through taxonomy, organ-isms are arranged into related groups based on similarities in **morphology**, **anatomy**, **physiology**, genetics, **ecology** and **distribution**.

All organisms are grouped into large groups known as kingdoms. There are five major kingdoms:

1) Animalia (mammals, **insects**, birds, reptiles, etc.);
2) Plantae (plants);
3) Fungi (mushrooms, molds, yeasts, etc.);
4) Protista (some **algae** and protozoans); and
5) Monera (bacteria and blue-green algae).

These kingdoms are further divided into more closely related groups down to a specific organism.



For example, let's trace the taxonomic classifications of a dragonfly. Dragonflies belong to the kingdom Animalia. From here they are divided into the phylum Arthropoda, which contains all insects and their relatives. Next, they are placed in the class entitled Insecta. In North America alone, there are 88,600 species of insects. The class Insecta is further divided into groups called orders. In North America, there are 27 orders, each order containing closely related insects. Dragonflies are in the order Odonata. They are further divided up into families, then **genus** and finally **species**. Worldwide there are about 4,500 species of dragonflies, while in North Carolina there are only 186 species. To discover what species we have in North Carolina, we would use an identification key.

Keys:

A key is an essential tool used by people studying the science of taxonomy. It is defined as "an ordered list of significant characteristics of a group of organisms used to identify unknown organisms." Simply put, a key is a list of characteristics that describe an organism. Keys are used by scientists and students to identify unknown organisms. Keys often use a combination of pictures and written descriptions to aid in identification. Once you know the name of an organism, then you can look up information about it.

Dichotomous Keys:

Most keys are **dichotomous**, which means dividing or branching into two parts. A dichotomous key, therefore, is a key that divides the characteristics that describe an organism into two choices. At each level of the key, you pick the choice that best describes the organism you are trying to identify.

How a Key Works:

Here's how a dichotomous key works. A list of characteristics arranged as a series of either/or statements is used for identifying plants and animals. For each pair of statements, choose the one that best describes the item you're identifying. For example, if you were handed a leaf from a pine tree to identify, you would start at the top of the tree identification key with these two choices:

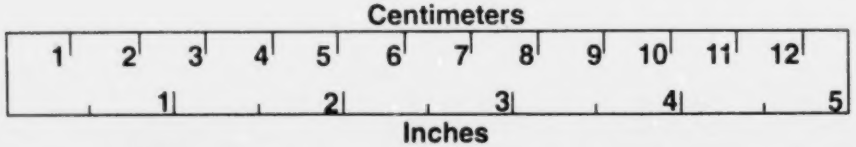
1. Leaves not long or needle-like.
2. Leaves long and needle-like.

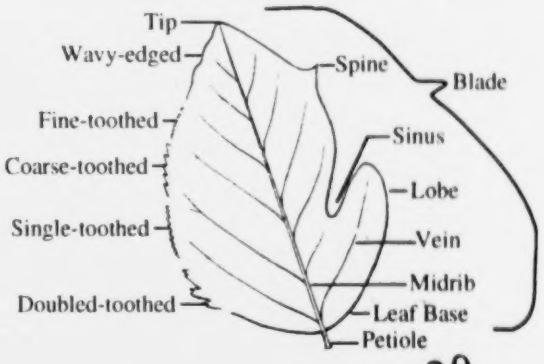
Of course, a pine leaf (or needle) is long and needle-like so you would choose option number 2 and continue to the next choice under that side of the dichotomous key.

Key to 10 Common Leaves

(Tree Leaves)

- Leaf long & needle-like
  - Leaves in groups of 2; less than 7 cm long — *Virginia pine*
  - Leaves in groups of 5; more than 7 cm long — *White pine*
- Leaf not needle-like
  - Leaf with lobes
    - Edge of leaf without teeth
      - Petiole of leaf 1 cm or longer
        - Leaf petiole less than 2 cm — *Sassafras*
        - Leaf petiole longer than 2 cm — *Tulip poplar*
      - Petiole of leaf less than 1 cm — *White oak*
    - Edge of leaf with teeth
      - Leaf with 5 lobes; petiole 3.5 cm or longer — *Sweet gum*
      - Leaf with 3 lobes; petiole shorter than 3.5 cm — *Red maple*
  - Leaf without lobes
    - Leaf edge with teeth
      - Each tooth with spine — *American holly*
      - Teeth without spines — *River birch*
    - Leaf without teeth — *Catawba rhododendron*





March 1994

3.1.4

New River State Park, NC

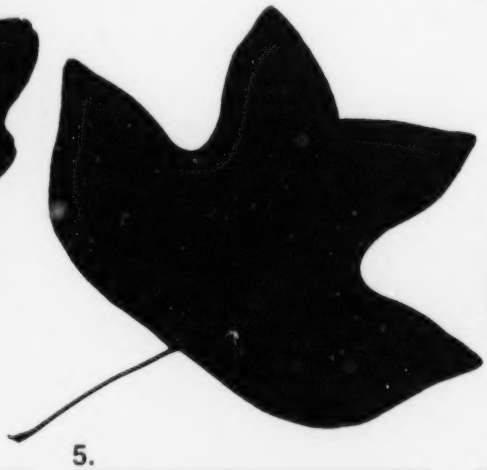
10 Common Leaves

1. _____

2. _____

3. _____

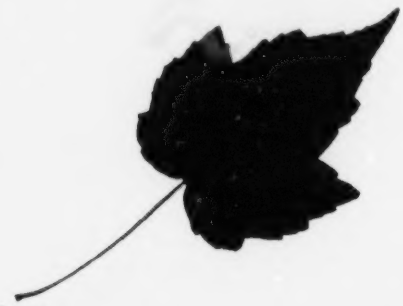
4. _____



5. _____

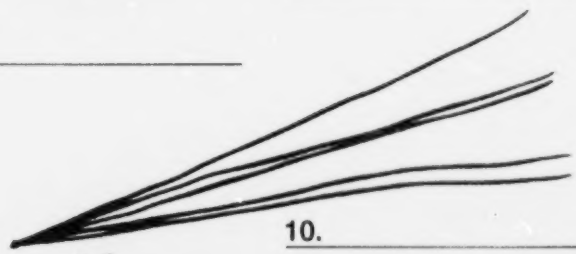
6. _____

7. _____



8. _____

9. _____



10. _____

Key To Aquatic Macroinvertebrates
of the New River

March 1994

3.1.6

New River State Park, NC

Macroinvertebrates

- With shells
  - Double shell
    - Shell nearly uniform in shape (rounded) → Freshwater clam (M)
    - Shell longer than wide → Freshwater mussel (I)
  - Single shell
    - Spiral shell → Pouch snail (I)
    - Coiled shell → Ramshorn snail (I)
- Without shells
  - Obvious legs
    - Three pairs of legs
      - Two pairs of wings extending over abdomen
        - Beetle-like appearance
          - Hind legs short → Whirligig beetle adult (M)
          - Hind legs long
            - Swims on back two long oar-like legs → Backswimmer adult (M)
            - Crawls on rocks, black body → Riffle beetle adult (M)
        - Thin body with wide spread legs
          - Active on water surface → Water strider adult (M)
          - Active under water surface → Water scorpion adult (M)
      - No wings
        - Body with hardened exoskeleton, flattened
          - Body white to greenish with or without a portable case → Caddisfly larva (I)
          - No tail-like appendages small round → Water penny Riffle beetle larva (I)
          - Tail-like appendages
            - Two tailed → Stonefly nymph (I)
            - Three tailed
              - Long conspicuous tail appendages
                - Tail appendages bristle-like → Mayfly nymph (I)
                - Tail appendages broad & oar-like → Damselfly nymph (M)
              - Short inconspicuous tail appendages → Dragonfly nymph (M)
        - Entire body soft/cylindrical
          - Body dark, head with prominent pinchers
            - gill tufts at base of lateral appendages → Dobsonfly larva (I)
            - no gill tufts → Fish fly (I)
    - More than three pairs of legs
      - Lobster-like → Crayfish (M)
      - Shrimp-like body flattened to side, swims with legs → Scud (M)
  - No obvious legs
    - Caterpillar-like
      - Distinct head, enlarged abdomen → Black fly larva (T)
      - No distinct head, body tapered at both ends → Crane fly larva (M)
    - Worm-like
      - Body with suction disks at both ends → Leech (T)
      - Body without suction disks → Freshwater worm (T)

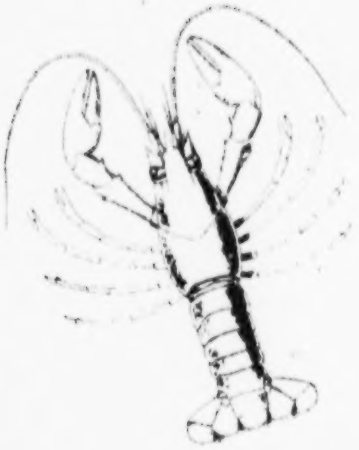
Legend

Pollution Tolerance	Index Value
(I) - Intolerant	Group I
(M) - Moderate	Group II
(T) - Tolerant	Group III

McCafferty, Aquatic Entomology
© 1981 Boston, Jones and Bartlett Publishers
Reprinted by permission

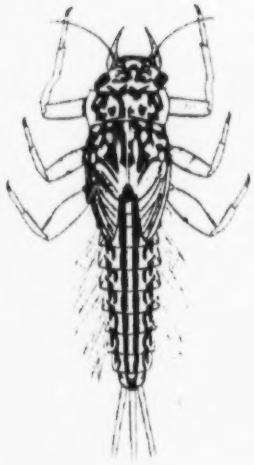
Aquatic Life Illustrations

1. _____

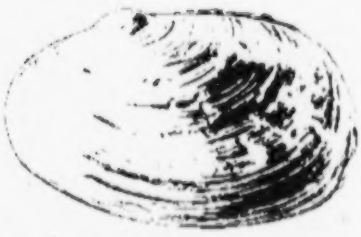


2. _____

3. _____



4. _____



5. _____

6. _____

Reprinted by permission

Answer Sheet to 10 Common Leaves

1. *Catawba rhododendron*

2. *Sassafras*

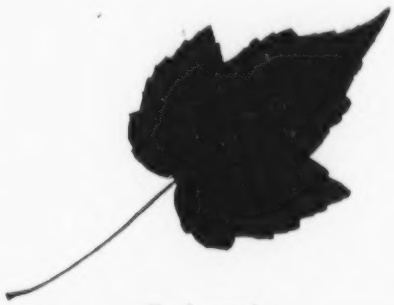
3. *Sweet gum*

4. *White oak*

5. *Tulip poplar*

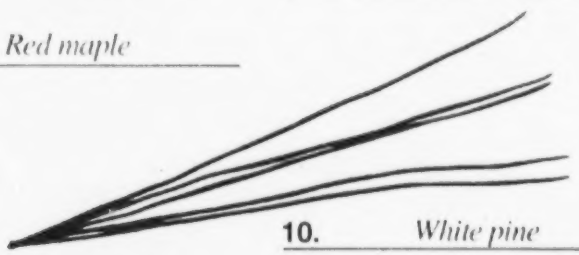
6. *River birch*

7. *American holly*



8. *Red maple*

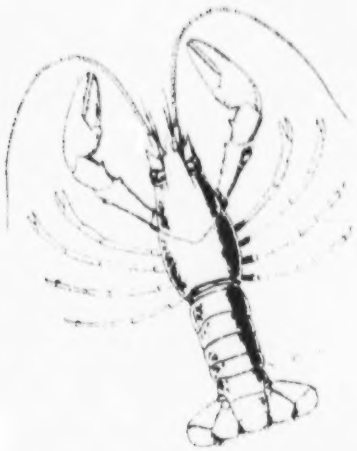
9. *Virginia pine*



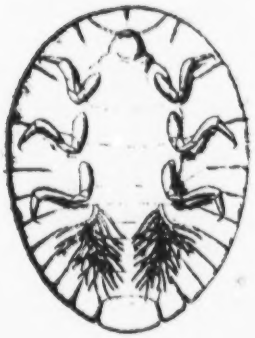
10. *White pine*

Answer Sheet to Aquatic Life Illustrations

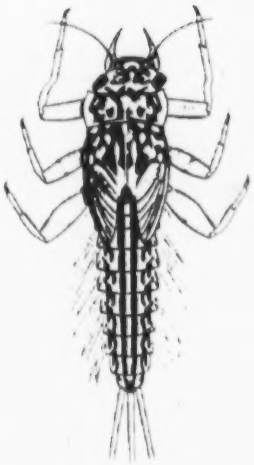
1. *whirligig beetle*



2. *crayfish*



3. *water penny*



4. *mayfly nymph*

5. *freshwater mussel*

6. *caddisfly larva*

M.C. Gilbert. Aquatic Entomology. © 1991. Jones and Bartlett Publishers. Reprinted by permission.

Reprinted by permission.

On-Site Activity #1 — Life in the Fast Stream

Curriculum Objectives:
Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: being responsible in a group
- Mathematics: whole numbers, measurement
- Science: interactions of people and the environment, organization and variety of living things, plant and animal communities
- Social Studies: evaluate, organize, and analyze information draw, conclusions

Grade 8
- Communications Skills: listening, visual, reading and vocabulary comprehension
- Mathematics: whole numbers, measurement
- Science: adaptation, ecology
- Social Studies: evaluate, organize and analyze information, draw conclusions

Location:
New River, Wagoner Road Access Area

Group Size:
30 or fewer, in groups of 5 or less

Estimated Time:
1 - 1 1/2 hours

Appropriate Season:
Late May to early October

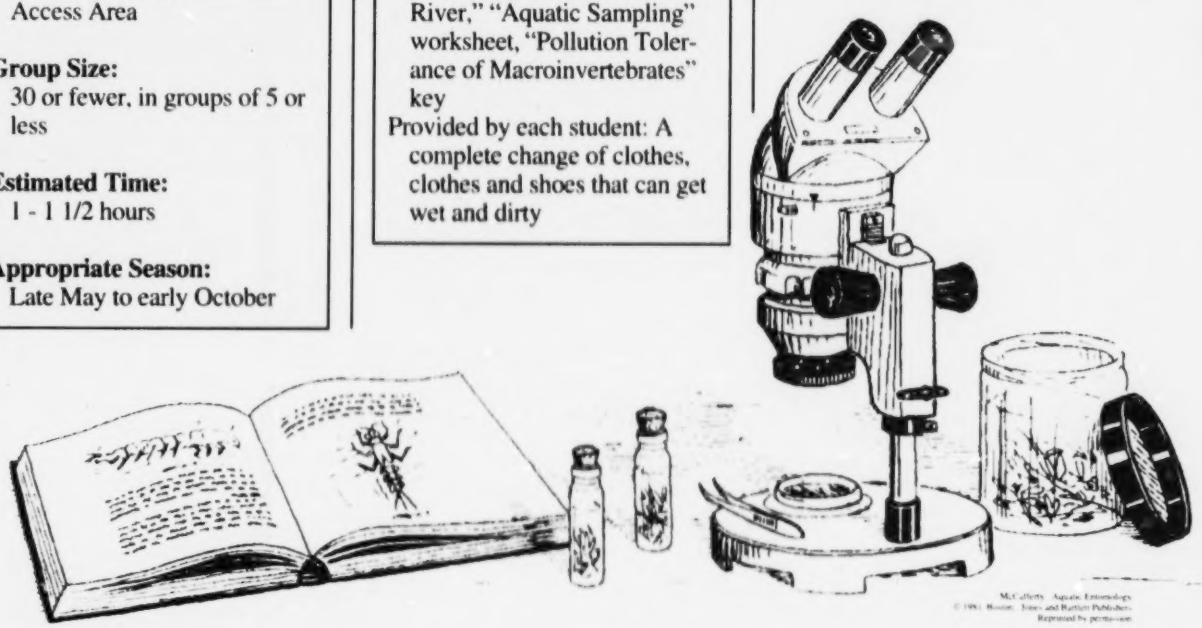
Credits:
Adapted from "A Field Manual for Water Quality Monitoring, an Environmental Education Program for Schools" by Mark K. Mitchell and William B. Stapp; and Aquatic Project WILD Guide - "Water Canaries" activity, 1986, Western Regional Environmental Education Council.

Materials:
Provided by park:
Per student: life jacket, pencil
Per group: kick net, dip net, rubber gloves, wide mouth plastic jars, aquariums, plastic tubs, dissecting scope, magnifying glasses, tweezers, clipboard, field guides to aquatic life, laminated fish and invertebrate keys, aquarium nets, plastic spoons, extra activity sheets, examples of adult macroinvertebrates
Per class: remarkable board, rescue throw rope
Provided by the educator:
Per student: "Key to Common Macroinvertebrates of New River," "Aquatic Sampling" worksheet, "Pollution Tolerance of Macroinvertebrates" key
Provided by each student: A complete change of clothes, clothes and shoes that can get wet and dirty

Note: There is a public restroom located close to the activity site where the students can change clothes.

Special Considerations:
Remind the students of the appropriate dress for the on-site activity (i.e. old shoes without holes in them, old jeans, etc.) Students must wear life jackets and shoes during this activity. Students should wear gloves when sorting and handling organisms so they can be returned without injury to the water after the activity.

It is the responsibility of the educator and group leaders to be aware of special considerations, medical needs, disabilities, etc., of participants and be prepared to take appropriate precautionary measures. Park staff should be informed of any special considerations prior to the group's arrival at the park.



Major Concepts:

Part I

- Water quality
- Aquatic sampling
- Indicator species
- Aquatic habitats
- Species identification
- Biotic index
- Human influence on water quality

Part II

- Water flow
- Human influences on water flow and aquatic life
- Natural influences on water flow and aquatic life
- Water quality
- Stewardship

Objectives:

Part I

- Describe three characteristics of an aquatic macroinvertebrate.
- Key out five macroinvertebrates.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Calculate the biotic index.
- List three or more ways humans affect aquatic life.

Part II

- Calculate the rate of water flow.
- List three human actions and three natural influences on water flow.
- Explain the relationship between water quantity and quality.
- Describe three problems that can result from water quantity extremes and three from water quality changes.
- Discuss two ways people can help protect rivers and water quality.

Part I: What's In The Water?

Educator's Information:

To prepare your students for their visit, have the students read the Student's Information and complete the pre-visit activity "The Keys To Knowledge." Discuss these topics as a class prior to your visit.

In the early days of coal mining, canaries were taken into mines. Canaries are more sensitive than humans to the presence of dangerous gases in the air, therefore their discomfort or death indicated the air was unsafe for the miners to breathe. Although this practice no longer exists, it stands as an example of how animals have different sensitivities to environmental factors than humans.

In **aquatic** and terrestrial environments, certain organisms called **indicator species** can reveal much about the quality of the environment. These creatures comprise a **biotic index**. Their absence or presence tells us something about the environment's quality.

Water **habitats** with rich and varied ranges of aquatic creatures are usually "**healthy**" environments, whereas **water** with just a few different species usually indicates conditions that are less "healthy." Healthy is a term used here to indicate an environment that supports a wide variety of living things. **Pollution** reduces the quality of the environment and in turn the **diversity** of life forms. In some cases the actual biomass, or amount of living material, will increase due to pollution, but the diversity inevitably goes down.

The major purpose of this activity is to introduce students to **macroinvertebrates** and aquatic **organisms** and how they can be used as indicator species to determine the health of a river. We expect the students will find the biotic index for the New River very high, due to the quality of the water.

The students will be involved in collecting macroinvertebrates from the river and must be dressed appropriately. Life jackets must be worn at all times. A first aid kit will be available. The park staff will rope off an area where the sampling will occur. They will discuss safety considerations and the educator will

assist in seeing that all safety precautions are followed. The students will work in groups of four or five, with one person in each group recording the data. After completing the worksheets, students will gather and discuss their results.

Start by observing the water. Look for organisms on the surface and in the depths. Using the sampling equipment (nets, trays, assorted containers, etc.), students should collect as many different forms of aquatic animal life as possible. Ask them to be alert to differing micro-habitats located near rocks, in **riffles** and in eddies. Place the collected animals in the white trays, plastic jars or aquariums for viewing and keying out. The whiteness of the trays allows details to be seen in the animals collected. Keep an adequate amount of water in the trays and place them in a cool, shady spot. Change the water as often as necessary to keep the animals cool and alive.

Note: These animals are protected by park rules and regulations. By exercising care all the animals can be returned to their home without being harmed.

Have the students use their aquatic macroinvertebrate identification **key** to identify the animals. Have them fill out their worksheets listing the number of each species found and describing the actual locations where they were found, i.e., in pool areas, under rocks, the water's surface, etc. Once these observations and the worksheets are completed, carefully return the animals to their natural habitat.

Encourage the students to discuss their observations. How many different aquatic animals were found? Discuss diversity of life and that a variety of different kinds of plants and animals is usually an indication of a healthy **ecosystem**.

Student's Information

"**Water**, Water everywhere nor any drop to drink."

So says the sailor in Samuel Taylor Coleridge's "Rime of the Ancient Mariner" as their boat is becalmed at sea. Fortunately, in our area fresh water is abundant and there seems to be plenty to drink. But that may be changing as this area becomes more developed and is used by more people. Let's take a closer look at water and discover what a fragile and sensitive resource it is.

What is water? The dictionary defines water as a colorless, odorless, transparent liquid occurring on earth as rivers, lakes, oceans, glaciers etc., and falling from the clouds as rain, snow, ice, etc. Water occupies more than 70 percent of the earth's surface, and it makes up approximately 60 percent of the human body. You may have heard the saying "Water is life." Think about that for a minute. Can you think of any living **organism** that does not depend on water?

David Quammen, in his book, *Natural Acts, A Sidelong View of Science and Nature* says, "Without life, there would still be water. Without water, no life."

Recipe for a River

Water comes in many forms. To really appreciate it you need to pick out one of its many forms and get to know it personally. During your visit to New River State Park you will learn more about water in the form of a river.

What is a river? A river is defined as a large, natural stream of water emptying into an ocean, lake or other body of water and usually fed along its course by converging **tributaries**. The New River is one of the oldest rivers in the world which is one of the reasons that the New River State Park was established. The river is the result of springs, streams and creeks joining together to produce a larger **volume** of flow. These smaller bodies of water are called tributaries. The land that a river and its tributaries flow through is called a **watershed**. A **healthy** river must have a well protected watershed because any kind of disturbance to the watershed has an effect on the river.

Life in a River

The various forms of life found in a river can be compared to a fine stew or soup. Just like a river, a fine stew or soup needs lots of different ingredients. Usually the more you add, the better the stew. A stew also needs small amounts of spices to make it taste just right. If you try to make a stew with just one ingredient, or if you leave out an important spice, your stew is not going to be good. Here then is a recipe for a fine, healthy river.

Some sunlight - just enough for **algae**, moss, diatoms and **aquatic** plants to **photosynthesize**. (Too much sun heats up the water and robs it of **dissolved oxygen**.)

Dissolved oxygen and carbon dioxide - all the animals in the river need dissolved oxygen to breathe. These same animals breathe out carbon dioxide which is essential for algae and other aquatic plants. These plants in turn take in the carbon dioxide and give off oxygen.

Fallen leaves - they provide the main source of food energy in a river system. In the fall, leaves drift down from the trees into the water where they soon sink to the bottom or get caught in logjams or become wedged between rocks. At this point, bacteria and fungi climb aboard the leaves and begin to "munch out," causing the leaves to decompose and break down into smaller pieces. The half-eaten leaves, along with the **decomposers**, are eventually swept downstream. They provide food for filter feeders - the wonderfully adapted **macroinvertebrates** (macros), such as stonefly **nymphs**, mayfly nymphs, and caddisfly **larvae**. These organisms

further break down the leaves into a very fine mulch called **detritus**.

In addition to the munchers, grazers and filter feeders, there are macroinvertebrates that prey on other macros. Lots of different kinds of macros are a sign of a healthy river.

Aquatic plants and animals - aquatic plants provide cover for macros and small minnows. The aquatic plants and animals in the river, and those living along the river provide food for each other in a complex **food web**. When all these various plants and animals die or excrete waste, they return essential nutrients back into the **food chain**.

Various minerals - the fine spices of a river include calcium bicarbonate, potassium, nitrates and phosphates. These ingredients help balance a rivers pH, provide building material for the shells of **snails**, **mussels**, clams and crayfish, help fish breathe more efficiently and act as natural fertilizers essential for aquatic plants.

These are just the minimum ingredients needed for a healthy river. Now mind you, a river needs only natural ingredients, unnatural ingredients can have a bad effect on a river. David Quammen sums up what makes a healthy river when he talks about a trout stream.

"A good trout stream must first be an excellent insect stream, a superior haven for algae and fungi and bacteria, a prime dumping ground for dead leaves, a surpassing reservoir of oxygen and calcium. It will then also, and thereby, be a good **osprey** stream, a favorite among otters, a salvation to dippers and kingfishers and bank swallows and heron, mergansers and Canada geese and water shrews, mink and muskrat and beaver. Not to mention the occasional bear. And who knows but that, sometime, a human might want to drink."

If there are large numbers of many different species of plants and animals in the water, then we have a healthy river. Taking samples of these aquatic plants and animals is a means to monitor the **quality** of a river's water.

Reproduced by permission.

Instructions:

1. Park staff will lead a brief discussion focusing on: macroinvertebrates (macros), what they are and why they are important; **metamorphosis**, what it is and how it is accomplished; and **indicator species**, what they are and how they are used to determine the health of a river. The staff will point out and describe the river's environment: **riparian** areas, flood plain, **pools**, eddies, ripples, etc. Park staff will also cover how to use sampling equipment and safety precautions that must be followed when using the equipment.

2. Have the students predict the **biotic index** for the New River on their worksheets.

3. Briefly review the macroinvertebrate **key**. Be sure to point out that the key is not complete and the students should therefore key organisms as closely as possible. For example, there are 186 dragonfly **species** in North Carolina, and the key only shows one dragonfly larva species, but the illustration should be close enough so the students will be able to identify any dragonfly larva they find.

4. a. Divide the class into groups of five or less and distribute their equipment.

b. Instruct the students on the proper way to collect samples using dip, seine and kick nets.

c. Fill the white trays, aquariums and plastic jars half way with water from the river.

d. Have the students net their samples in the roped off area.

e. As soon as the samples are collected, the groups should move to the river bank.

f. Allow the excess water to drain from the nets.

g. Put on rubber gloves and search for organisms. (They may want to use a magnifying glass.)

h. Using tweezers or hands, carefully remove any organisms found and place in the white tray, aquarium or plastic jar for observation and identification.

5. After collecting samples, each group should identify the aquatic macroinvertebrates using the "Key to Common Macroinvertebrates," field guides and dissecting scopes. Have them record their answers on the "Aquatic Sampling Data Sheet" and use their results to determine the Biotic Index Value (relative health) of the river.

The Biotic Index Value groups macros into three groups based upon how tolerant or sensitive they are to changes in **water quality**.

Group I includes macros that are very intolerant to water pollution. The dominant presence of Group I species is an indication of good water quality. Group I is given an index value of 3. Group II includes macros that are moderately tolerant to a reduction in water quality. They are given an index value of 2. Group III represents macros that are tolerant to pollution. Their dominance indicates poor water quality. They are given an index value of 1. The students will learn how to calculate the Biotic Index Value by using a simple formula:

(3 x no. of Group I)
(2 x no. of Group II)
+ (1 x no. of Group III)

= **Biotic Index Value**

6. Return all organisms to the water as quickly as possible after the observation and identification is complete to help insure that the organisms are not harmed.

7. After the students have identified their specimens and determined the Biotic Index Value, park staff will lead a group discussion summarizing what the students have learned, what they've identified from the river, and the importance of indicator species and the Biotic Index Value.

8. Instruct the groups to gather and clean their equipment. The rangers will tell the students where the equipment should be placed.

9. Assemble the class and have each group present their findings. According to their study, what is the rating of the New River's water quality? How does it compare to the students' initial prediction? If different, encourage students to explore reasons. Do different groups have different results? If so, explore reasons why. (Answers: improper collection or identification techniques by some; luck of the hunt, etc.)

Aquatic Sampling Worksheet

Name: _____ Date: _____

Location: _____

Methods used to sample: _____ Biotic Index Value: _____

A. Prediction of the New River's Biotic Index: Excellent Good Fair Poor

Circle your choice. Why do you think the New River will have this Biotic Index?

_____

_____

B. Instructions:

1. Use the "Key to Aquatic Macroinvertebrates" or "Pollution Tolerance of Macroinvertebrates" chart to identify organisms.

2. Record the species of organisms found in the space below, using the chart to classify them by their tolerance levels. (See example below.)

Group I	**Group II**	**Group III**
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
Total =	Total =	Total =

3. Calculate the Biotic Index Value by multiplying the number of species of organisms in each group by the index value for that group. Then, add the resulting three numbers to obtain the Biotic Index Value (see example below).

(3 x no. of species - Group I)
(2 x no. of species - Group II)
+ (1 x no. of species - Group III)
= **Biotic Index Value**

Cumulative Index Values	**Biotic Index Rating**
23 and above	Excellent
17 to 22	Good
11 to 16	Fair
10 to less	Poor

Group I	Group II	Group III
1. hellgramite 4. caddisfly	*1. dragonfly*	*1. black fly*
2. mayfly 5.	*2. crayfish*	*2. freshwater worm*
3. snail	*3.*	*3.*

(3 x **4**) + (2 x **2**) + (1 x **2**) = **18**

[**18** is the biotic index value, which is a good rating according to the chart above]

Adapted from *A Field Manual for Water Quality Monitoring*. An Environmental Education Program for Schools by Mark K. Mitchell and William B. Stapp.

4. How would you describe the river's water quality based on its Biotic Index?

5. What do you think has caused or contributed to the water quality?

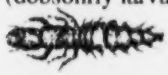
Pollution Tolerance of Macroinvertebrates

Group I - Index Value = 3

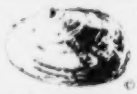
These macroinvertebrates can not tolerate pollution or changes in water quality. Their presence or dominance generally indicates good water quality.

mayfly nymph

Hellgrammite
(dobsonfly larva)



freshwater mussel



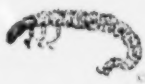
stonefly nymph

riffle beetle adult

right-handed pouch snail

water penny
(riffle beetle larva)

caddisfly larva



Group II - Index Value = 2

These macroinvertebrates can exist in a wide variety of water quality conditions.

dragonfly nymph

damselfly nymph

crayfish

freshwater clam

scud

whirligig beetle

water strider

Group III - Index Value = 1

These macroinvertebrates can exist in polluted water. Their dominance indicates poor water quality.

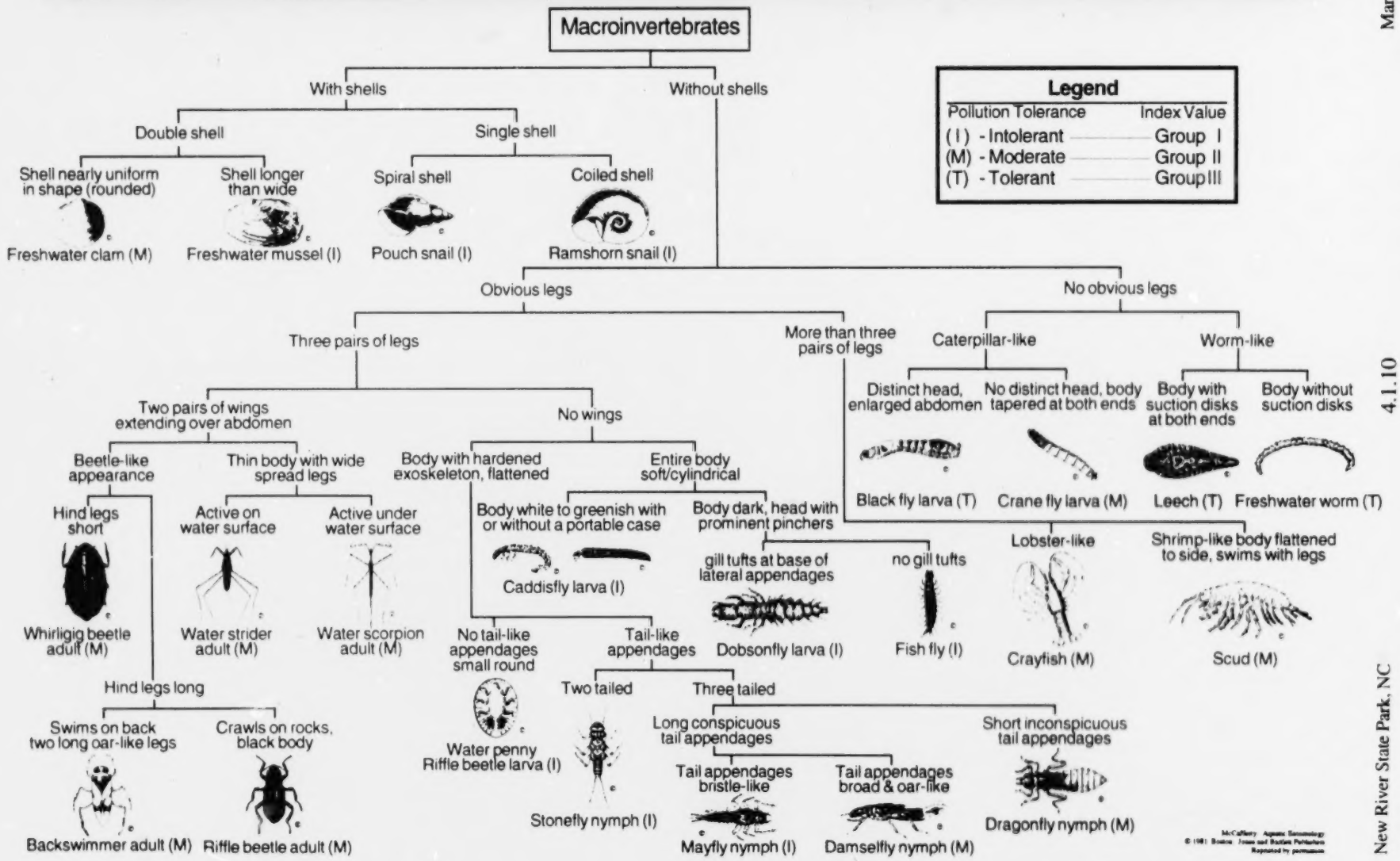
black fly larva

leech

freshwater worm

McCafferty, Aquatic Entomology
© 1981 Jones and Bartlett Publishers
Reprinted by permission

Key To Aquatic Macroinvertebrates
of the New River



McCafferty, Aquatic Entomology
© 1981 Boston, Texas and Borders Publishers
Reprinted by permission

March 1994

4.1.10

New River State Park, NC

Part II: Calculating Water Flow of the New River

Educator's Information:

In this activity, the students will learn a simple method for determining water flow. They will then use this information to explore the ways water flow and water quality are affected by human and natural factors. They will also be asked to think of ways they can influence local government to protect water quality.

Have students read the Student's Information. Discuss this information in class prior to your visit.

Instructions:

1. Lead a brief discussion concerning the importance of water flow in maintaining water quality. Explain that in this activity, the students will learn how to calculate water flow and thus be able to evaluate this aspect of the New River's water quality.

2. Explain the method for measuring water flow and safety procedures that must be followed.

3. Select three students, wearing life vests, to get in the water. Have two students measure the length and width of the flow space and one student measure the depth. Have the other students write down the measurements on their worksheets.

4. Select four students, wearing life vests, to measure the rate of flow. Have two students, each with a bouyant ball, go to the upstream end of the flow space. Have two other students, each with a stopwatch, go to the downstream end of the flow space. The student with ball #1 should place it in the river, upstream from the beginning of the flow space, and hold his/her hand in the air. As the ball passes the beginning of the flow space, he/she quickly drops his/her hand. This is the signal for the student with stopwatch #1 to start the stopwatch. The stopwatch is stopped the moment the ball passes out of the flow space. The student will then retrieve the ball, and they will repeat this procedure four more times. The students with ball #2 and stopwatch #2 will follow the same procedure as the #1 team. The other students will record the flow rates on their worksheets as the students with the stopwatches announce them.

5. Have all the students determine the averages and then calculate the water flow rate in cubic feet/second. Discuss these results and what they might mean to the New River's water quality.

6. Lead a discussion of factors that affect water flow (natural and human), and how these factors in turn affect aquatic life. Natural factors affecting water flow include drought, flooding and natural stream obstruction, i.e., beaver dams, rapids or log jams. Human activities that affect water flow include dams, irrigation, clear-cutting of timber, development along the river's corridor and industrial use. These natural and unnatural water controls can adversely impact aquatic organisms by reducing water flow and decreasing water quality.

7. Ask the students how they can influence the government to protect our water resources. Be sure to emphasize the importance of everyone being involved in caring for our resources (**stewardship**). The National Committee for the New River is an organization that exemplifies stewardship. If time allows, the leader will briefly explain how the park was created with the help of the National Committee for the New River.

Suggested Extensions:

1. Have the class compare their findings with other classes that have done this activity in the past by comparing worksheets. The worksheets may be different due to collection and identification techniques, luck of the hunt, weather, water level, season, etc.

2. Sample other streams and rivers in the area and compare their biotic index value with that of the New River.

Student's Information

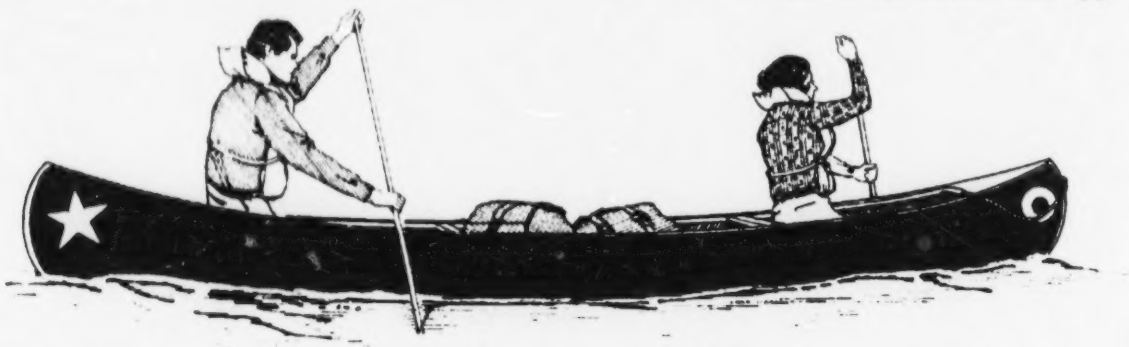
Water flow refers to the amount of water moving in a river or stream. Some of the ways we express the rate of flow are gallons per second, cubic feet per second or acre feet per second (an acre foot is equal to one acre of water one foot deep or 325,850 gallons of water). The following exercise will show you how to estimate water flow in cubic feet per second. Why is this important? Read the following story and discover why water flow is such an important concept.

The river is the Colorado. It begins in the Colorado Rockies and empties 1,450 miles later into Mexico's Gulf of California. The Colorado River provides water for seven western states. This includes water for human consumption as well as irrigation for farms and domestic livestock. The river also provides the necessities of life for many native plants and animals. The Colorado is one of the most controlled rivers in the world; it has scores of dams, hundreds of miles of aqueducts and tunnels, dozens of pumping stations, thousands of miles of canals, and more than 30 hydroelectric plants. Water is pumped from the Colorado to cities like San Diego, California; Las Vegas, Nevada; Denver, Colorado and Phoenix, Arizona. Each year 16.5 million acre feet of water are diverted from the Colorado River (multiply 16.5 million times 325,850 to see how many gallons are taken from the river each year). Sometimes the water level is so low that rafters can not run certain rapids in the Grand Canyon.

Dams above the Grand Canyon control how much water moves through the canyon. This has had a big impact on aquatic life. For example, before the Colorado River was dammed, the river flowed cold and carried lots of mud and **silt** during the spring floods and slowed to a warm clear trickle in the fall. Native aquatic species were well **adapted** to these specific conditions. Now dams trap **sediment** in huge reservoirs and constantly release clear cold water from the bottom of the lake. This has created excellent **habitat** for species brought in to the river, like trout, but is contributing to the near extinction of several **native** species of fish that do not tolerate the cold water well.

By the time the Colorado River reaches the Gulf of California there is barely a trickle of water, and at times the river dries up before it reaches the gulf. Even if there is water flowing, evaporation has caused the water to become so salty it cannot be used for irrigation.

A huge **delta** and **estuary** at the mouth of the Colorado was once one of the most productive in the Southwest, but a decrease in water flow has changed that. In 1922, ecologist Aldo Leopold explored the delta. He described it as a milk and honey wilderness where egrets gathered like a premature snow storm, jaguars roamed and wild melons grew. Since that time two marine animals have become endangered: a porpoise and a large fish called a totoaba. The totoaba spawned in the estuary and the tide carried their eggs



into the natural nursery of the delta. According to saltwater agronomist Nicholas Yensen, the river was like the Nile in its importance to the delta. Unknown species may have disappeared as a result of the decrease in water flow.

You might be surprised to learn that even the New River is affected by low water flow. Such conditions can have adverse effects on the entire aquatic **community**.

When water levels are low the water temperature can increase, which can result in less dissolved oxygen being available. This can be dangerous to macroinvertebrates and fish.

Algae, which uses tremendous amounts of oxygen as it decays, can spread rapidly during low water flow. Because of this, fish kills will sometimes occur because of insufficient dissolved oxygen.

During low water levels there is less habitat for river animals, making them more vulnerable to **predators**.

You might be forced to conserve water during low flow periods to make sure you and your neighbors have enough to drink and bathe.

We have talked a lot about low water levels, but high water levels can also affect life along the river. Heavy rains wash exposed **soil** into the river. This sediment can suffocate macroinvertebrates, kill fish eggs and alter habitats. Many towns and cities divert rain water into storm drains that empty into rivers. This storm water brings all kinds of nasty things into the river: vehicle oil and gas from pavements; chemicals used in farming and lawn care; overflow from waste water treatment plants; and trash from dumps and other sources.

As you can see, water flow is very important to us and the plants and animals that share the New River with us. Using water wisely and protecting our river's watershed from unwise use are two ways we can help maintain a healthy environment and a more natural water flow.

McCafferty, Aquatic Entomology
©1981 Boston: Jones and Bartlett Publishers
Reprinted by permission

How To Calculate Water Flow Worksheet

(A) - Average length of flow space
(B) - Average width of flow space
(C) - Average depth of flow space
(D) - Time of flow through space

Solving for (X) = water flow rate in cubic ft./sec.

Equation: (A) x (B) x (C) ÷ (D) = (X)

(A) Average length of flow space

North bank _____ ft. + South bank _____ ft. = _____ ÷ 2 = [_____ ft.]

(B) Average width of flow space

Up river _____ ft. + Down river _____ ft. = _____ ÷ 2 = [_____ ft.]

(C) Average depth of flow space

1._____ in. + 2._____ in. + 3._____ in. + 4._____ in. + 5._____ in. = [_____ in.]

[_____ in.] ÷ 5 = _____ in. ÷ 12 in. = [_____ ft.]

(D) Average rate of flow through flow space

Ball 1

1._____ sec. + 2._____ sec. + 3._____ sec. + 4._____ sec. + 5._____ sec. = [_____ sec.]

Ball 2

1._____ sec. + 2._____ sec. + 3._____ sec. + 4._____ sec. + 5._____ sec. = [_____ sec.]

[**Ball 1** _____ sec.] + [**Ball 2** _____ sec.] ÷ 10 = [_____ sec.]

Equation: _____ ft. x _____ ft. x _____ ft. ÷ _____ sec. = [_____ cubic ft./sec.]

(A) (B) (C) (D) (X)

How To Calculate Water Flow (Example)

(A) - Average length of flow space
(B) - Average width of flow space
(C) - Average depth of flow space
(D) - Time of flow through space

Solving for (X) = water flow rate in cubic ft./sec.

Equation: (A) x (B) x (C) ÷ (D) = (X)

(A) Average length of flow space

North bank 80 ft. + South bank 95 ft. = 175 ÷ 2 = **87.5 ft.**

(B) Average width of flow space

Up river 50 ft. + Down river 55 ft. = 105 ÷ 2 = **52.5 ft.**

(C) Average depth of flow space

1. 46 in. + 2. 35 in. + 3. 24 in. + 4. 32 in. + 5. 18 in. = **155 in.**

155 in. ÷ 5 = 31 in. ÷ 12 in. = **2.58 ft.**

(D) Average rate of flow through flow space

Ball 1

1. 20 sec. + 2. 22 sec. + 3. 27 sec. + 4. 32 sec. + 5. 30 sec. = **131 sec.**

Ball 2

1. 21 sec. + 2. 26 sec. + 3. 32 sec. + 4. 29 sec. + 5. 27 sec. = **135 sec.**

Ball 1 131 sec. + **Ball 2** 135 sec. ÷ 10 = **26.6 sec.**

Equation: 87.5 ft. (A) x 52.5 ft. (B) x 2.58 ft. (C) ÷ 26.6 sec. (D) = **445.6 cubic ft./sec.** (X)

Post-Visit Activity #1 — Judge and Jury

Curriculum Objectives:
Grade 7
- Theater Arts: display initiative, participate in creative drama
- Visual Arts: develop positive attitudes
- Communication Skills: listening, reading, vocabulary and viewing comprehension, speaking techniques
- Guidance: being responsible in a group develop an awareness of alternative points of view
- Science: interactions of people and the environment
- Social Studies: evaluate, organize, and analyze information, draw conclusions

Grade 8
- Theater Arts: participate in creating and producing simple, original scripts
- Visual Arts: develop positive attitudes
- Communications Skills: listening, visual, reading and vocabulary comprehension, speaking techniques
- Science: science and its relationship to human endeavors
- Social Studies: evaluate, organize, and analyze information, draw conclusions

Location:
Classroom, with chairs arranged to represent a courtroom

Group Size:
One to several classes

Estimated Time: 45 minutes

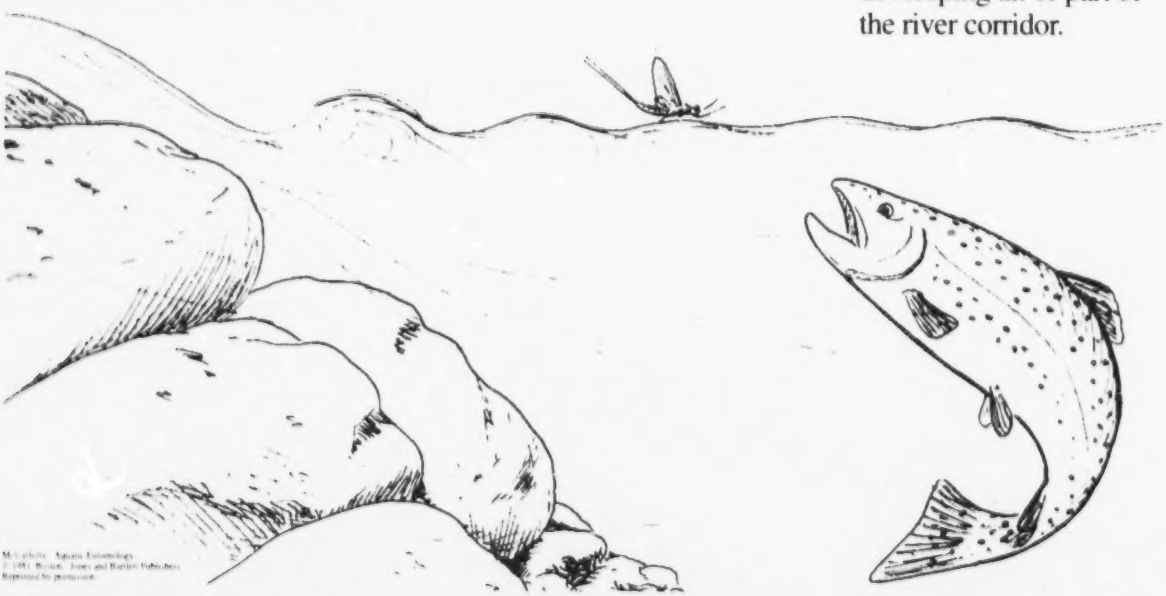
Appropriate Season: Any

Materials:
Provided by the educator: two clipboards with paper, two pencils, enough copies of background material for entire class

Special Considerations:
This role playing activity is to be used as a learning tool, designed to demonstrate the valid concerns that exist on many sides of various land use questions. The purpose is not to cast preservationists as "good guys" and developers as "bad guys." It is not intended to be taken too seriously nor to place any student, who may have personal affiliations with the groups involved, in an awkward situation.

Major Concepts:
- Stewardship
- Cultural conflicts
- Land use changes

Objectives:
- Present rational points in a debate over land use.
- List three reasons for preserving and protecting the river corridor.
- List three reasons for developing all or part of the river corridor.



Instructions:

1. Have the students read the background material "Introduction to New River State Park" on page 1.2 and the Student's Information for this activity to acquaint themselves with the issues.

If possible you might have the students read *The New River Controversy* by Thomas J. Schoenbaum.

2. Have the students choose three judges from their peers who will "try the case" to decide how land along the New River should be used.

3. Divide the remaining students into two equal groups.

Situation #1: Appalachian Power Company versus Conservation Coalition.

4. Appoint one group to be the Appalachian Power Company and the other to be the Conservation Coalition.

5. Have each group appoint a recorder, who will write down the issues important to the group, and a lawyer, who will act as the group's spokesperson.

6. Give each recorder a clipboard, paper and pencil.

7. The two groups should separate and discuss among themselves why the New River should or should not be dammed.

8. After 10 minutes of discussion, the lawyer from each group should present their group's case regarding how the land should be used to the three judges.

9. Give the judges three to five minutes to deliberate, then have them deliver their verdict to the class with the reasons for their decision.

10. After the verdict has been given, lead a discussion on why the river is still free-flowing and not dammed.

11. Have the students choose three new judges and have the old judges join the groups.

Situation #2: Developers versus Conservation Coalition

12. Let the Appalachian Power Company become the new Conservation Coalition and let the old Conservation Coalition become the developers.

13. The groups will again separate and list reasons why their vision of land use along the New River should be the one that is implemented.

14. Follow steps 4 through 9 again except now the question is whether there should be development along the New River State Park's 26.5 mile river corridor.

15. After the judges give their verdict, lead a discussion on the land use conflicts along the New River today.

Suggested Extensions:

1. Have the class discuss the land owned by the park. What are their ideas on the state's right to buy property even from people unwilling to sell? (The class may want to use this as a role playing situation as well.)

2. Have the class role-play that they are Ashe County land use planners and come up with a development plan for the New River.

3. Have the class attend a land use planning meeting and/or a county commission meeting where land use plans are decided.

4. Organize a "Stream Watch" group in your community. Stream Watch groups "adopt" a waterway, or portion of one, and act on its behalf. They take care of the waterway by monitoring water quality, providing educational programs, removing litter, etc. For more information on Stream Watch, contact:

Stream Watch Coordinator
Division of Water Resources
N.C. Department of
Environment, Health and
Natural Resources
P.O. Box 27687
Raleigh, NC 27611
Tel (919) 733-4064

5. Collect newspaper articles for local water related and land use issues as a current events activity.

6. Learn more about environmental impact statements. Try to obtain actual statements about natural areas in your region from local and state government offices. See what concerns are addressed in these documents.

7. Learn more about private organizations that work to protect natural resources. Examples include:

The North Carolina Environmental Defense Fund
128 E. Hargett St., Suite #202
Raleigh, NC 27601

The North Carolina Nature Conservancy
Carr Mill Mall, Suite 223
Carrboro, NC 27510

National Committee for the New River
P. O. Box 1107
Jefferson, NC 28640

Trout Unlimited
800 Follin Lane
Vienna, VA 22180-4959

North Carolina Wildlife Federation
P. O. Box 10626
Raleigh, NC 27605
Tel. 919-833-1923

8. Find out about zoning laws and land use regulations in your area by contacting the following:

City/County:
Ashe County Planning Board
Jefferson, NC 28640
Tel. 910-246-8841

State:
Winston-Salem
Regional Office
Division of Community Assistance - Planner
8025 North Point Blvd.
Winston-Salem, NC
27106-3256

Region D -
Council of Government
Planning Specialist
P. O. Box 1820
Boone, NC 28607
Tel. 704-265-5434

Would the plan your group proposed for the river watershed be allowed in your community?

9. Send a representative sample of the students' land use plans to the park. (We would appreciate the feedback.)

10. Write to the Ashe County Planning Board about any concerns you have with the water quality of the New River's watersheds.

Ashe County Planning Board
Jefferson, NC 28640
Tel. 910-246-8841

Student's Information

Every human use of land in the New River **watershed** has a positive or negative effect, not only on the New River, but on the **water**, wildlife and people downstream, all the way to the Gulf of Mexico. What we do with land is a reflection of our priorities, lifestyles and conservation ethics. The search for a modern day "good life" and all of its conveniences produces mixed results for plants, animals, **water quality** and people in the New River watershed. Some people see our natural resources as little more than raw material for human use. Others believe that a natural environment is to be preserved completely undamaged by humans and their lifestyles. Still others believe there should be a balance between development and protection of our resources. Very real differences of opinion regarding these issues exist between well meaning people.

Given the extensive impact humans have had and continue to have on the earth, a major challenge we now face is how to act more responsibly. We must develop the awareness, knowledge, skills and commitment necessary to encourage others to act more responsibly when it comes to taking care of watersheds and the remaining natural areas. We must develop the necessary understanding to restore areas where human disturbance has existed for centuries.

At the core of land use issues is the concept of growth. Growth in natural systems has inherent limitations, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space and continued survival. This means that the vitality of natural systems is expressed by their ability to be self-regulating. This capacity for self-regulation makes it possible for all natural members of an **ecosystem** to live in harmony. All life forms of any ecosystem must be considered. The **macroinvertebrates** in the water

are just as necessary to a **habitat** as the plants and fish. It is this natural, dynamic balance, with all its inherent and essential parts, that much of human land use has tended to disturb. Human activities often go beyond the natural limits of an ecosystem.

The New River area is growing rapidly. People are seeking undeveloped land along the river to build homes for retirement and for vacation homes. Development, however, often conflicts with trying to protect the river's water quality, the plants and animals that live in and around the river and preservation of the area's natural beauty. This is where different people have different ideas about how to best use the land and water from New River and still ensure that the river remains an **outstanding resource water**.

Think back to your visit to New River State Park. We know the New River provides water to many towns and cities which is used in a variety of ways, including water for drinking, for industry and sewage treatment. Many different forms of recreation are enjoyed on and around the New River, including fishing, canoeing, tubing, hiking and nature study. The river is also home to a wide variety of plants and animals.

Soon water will be taken out of the New River to provide drinking water for West Jefferson and Jefferson. We know that water is taken from the New River for irrigation. Many different forms of recreation are enjoyed in the New River watershed. The New River and its watershed provide crucial habitat for many plant and animal species. The Kanawha Minnow and Kanawha Darter are two animals that are endemic to the New River watershed. Endemic means they are found in these watersheds and nowhere else on earth!

Humans have the ability to import energy sources that allow a system to exceed its natural limits–or to remove energy sources that are necessary for a system to stay in balance. For example, people can dam rivers to make lakes which provide power and irrigation. Water from New River can be used in factories, farms, mills and other industries that need large amounts of water to produce certain products. All of these activities affect the life in and around the New River.

So how do we make land use decisions that will benefit the local economy and still protect our natural resources?

McCafferty, Aquatic Entomology
© 1981, Boston: Jones and Bartlett Publishers
Reprinted by permission

The following activity is designed to give you an understanding of how difficult the decision making process can be.

The New River area of northwest North Carolina and southwest Virginia was used as a hunting ground by Native Americans when the first European settlers arrived in the late 1600's. The early settlers were from Virginia. They established an independent way of life and farmed the mountain valleys. Many of the farms in the area have been in the same family for over 200 years.

In the 1960's the Appalachian Power Company proposed building two dams on the New River as a source of recreation and hydroelectric power. Opposition to this plan came from a coalition of groups such as farmers, fishermen and canoeists who wanted to keep the river as it was.

The conflict from these opposing points of view came to an end when the coalition succeeded in having a 26.5 mile section of the New River established as a component of the National Wild and Scenic River system.

Conflict over land use along the New River continues today. This time it is between conservation groups who want to preserve the landscape and its traditional uses, and developers who want to build new homes along the designated Wild and Scenic section of the New River.

VOCABULARY

Adaptation - A change in the structure or activity of an organism that produces a better adjustment to its environment, thus enhancing its ability to survive and reproduce. For example, the flattened, oval shape of the larva of the riffle beetle (called a water penny) is an adaptation that helps it cling to the surface of rocks in swift waters.

Algae - Simple, one-celled or many-celled plants capable of photosynthesis. They are usually aquatic and have no true root, stem or leaf.

Anatomy - The branch of biology that deals with the structure of living organisms.

Aquatic - Living or growing in water.

Biology - The science that deals with the origin, history, physical characteristics, life processes and habits of living organisms.

Biotic index - Serves as an indicator of the health of a habitat. It is based on the tolerance or sensitivity of plants and animals to changes in environmental quality and is calculated using a simple formula. For example, the health of a stream is determined by the number of individual organisms plus the diversity of species found there.

Classification - The grouping of organisms into categories based on shared characteristics or traits. For example, any animal that has feathers is considered a bird and is placed in the class Aves. Furthermore, if the bird has its eyes in front rather than on the side of its head, it is a member of the order Strigiformes (the owls).

Community - A group of organisms living in a specific region under similar conditions, and interacting with each other through food webs and other relationships.

Decomposer - An organism whose feeding action results in decay, rotting or decomposition. The primary decomposers are bacteria and fungi. They are very important parts of a healthy ecosystem.

Decomposition - To rot or to break apart into basic components. Decomposition makes nutrients, such as nitrogen and phosphorous, available for use by other organisms.

Delta - A usually triangular alluvial deposit at the mouth of a river.

Detritus - Dead organic matter, such as fallen leaves, twigs and other plant and animal material, which exists in any ecosystem.

Dichotomous - Divided into two parts, groups or classes, such as a dichotomous key. Using a dichotomous key, one can identify an unknown organism by following the one branch of each pair that best describes the organism.

Distribution - The act of scattering or spreading out; the geographic range of an organism.

Dissolved oxygen (DO) - The amount of oxygen gas molecules dissolved in water. Fish and other aquatic animals depend on DO for respiration.

Diversity - In the context of these activities, diveristy refers to the variety (or number of different kinds) of species of plants and animals.

Ecology - The science of the relationships between organisms and their environments.

Ecosystem - Living organisms and their physical surroundings which interact with environmental conditions, such as temperature and rainfall, forming an interdependent system.

Estuary - The part of the wide lower course of a river where its current is met and influenced by the tides.

Food chain - The transfer of energy and material through a series of organisms as each one is fed upon by the next. For example: detritus >> caddisfly larvae >> sunfish >> otter.

Food web - The interlocking pattern of food chains which exist in an ecosystem.

Genus - In biology, a taxonomic category ranking below a family and above a species, used in grouping similar living things, either alone or followed by a Latin adjective or epithet, to form the name of an organism. It is the main subdivision of a family. For example all hickories belong to the genus Carya.

Habitat - The environmental conditions of an area where an organism naturally grows or lives; its environment.

Healthy - In the context of these activities, it refers to the cleanliness or purity of the stream water.

Indicator species - An organism whose presence or absence in a particular environment can be used to determine the health of that particular environment.

Insect - Any animal in the class Insecta, having a head, thorax, abdomen, and three pairs of legs on the thorax. Adults usually have one or two pairs of wings attached to the thorax as well.

Key - In the context of these activities, a key is an ordered list of significant characteristics of a group of organisms used to identify unknown species.

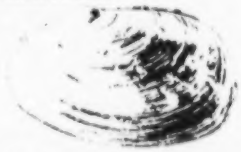
Larva (larvae, plural) - The immature form of an animal that changes structurally when it becomes an adult, usually by complex metamorphosis.

Macroinvertebrate - An invertebrate usually large enough to be seen without the aid of magnification. From *macro* "large" and *invertebrate* "without a backbone."

Metamorphosis - A change in form, structure or function as a result of development. A physical transformation undergone by various animals during development from the larval stage to the adult form. For example, through metamorphosis, a hellgrammite (larval form) becomes a dobsonfly (adult form). The change from a tadpole (larval form) to a frog (adult form) is another example of metamorphosis. From *meta* (change) and *morphe* (form).

Morphology - The biological study of the form and structure of living organisms.

Mussel - Any of various freshwater or saltwater bivalves (meaning the two shells are held together by a strong muscle).



Native - An organism originally found in a certain area; not foreign.

Nymph - The young of an insect that undergoes incomplete metamorphosis, differing from the adult primarily in size and structural proportions (i.e. wings).

Organism - A living thing. Examples include plants, animals, bacteria, virus and fungi.

Osprey - A fish eating hawk, having plumage that is dark on its back and white underneath.

Outstanding resource water - A legal designation given to very pure, unpolluted stream water.

Photosynthesis - The chemical process carried on by green plants in which the cells that contain chlorophyll use light energy to produce glucose (a plant food) from carbon dioxide and water; oxygen is released as a by-product. See: Respiration.

Physiology - The biological science of essential and characteristic life processes, activities and functions. All the vital processes of an organism.

Plankton - Collective term for the mostly microscopic plants (phytoplankton) and animals (zooplankton) that float or drift in oceans and freshwaters. These plants and animals are very important food sources in aquatic environments.

Pollution - A human-caused change in the physical, chemical or biological conditions of the environment that creates an undesirable effect on living things.

Pool - A deep, still spot in a river, creek or stream.

Precipitation - A general term for all forms of falling moisture including rain, snow, hail and sleet.

Predator - An animal that captures, kills and feeds on another animal.

Respiration - The process by which an organism takes in oxygen and releases carbon dioxide; breathing. See: Photosynthesis.

Riffle - A shoal or a gravel bar in a shallow part of a stream that produces a stretch of choppy ruffled water surface. This area has a higher dissolved oxygen level than a stream's pool areas.

Riparian - Pertaining to a bank of a river, pond or lake.

Sediment - Deposits of soil or organic matter which were suspended in water and then settled to the bottom. It is often deposited in the water by runoff.

Silt - A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Snail - An aquatic or terrestrial mollusk having a spirally coiled shell, a broad retractile foot and a distinct head.

Soil - A collection of organic and inorganic particles, mainly composed of clay, slit, sand and gravel.

clay - less than 1/256 of a millimeter (mm) in diameter
silt - between 1/256 and 1/16 of a mm in diameter
sand - between 1/16 and 2 mm in diameter
gravel - over 2 mm in diameter

Species - The taxonomic category located after genus which consists of organisms that have a high degree of similarity and can mate and produce fertile offspring.

Stewardship - The act of people taking responsibility for the protection and preservation of a clean and healthy environment.

Taxonomy - A branch of biology dealing with arranging and classifying organisms into natural, related groups based on some factor common to each, such as structure, embryology, biochemistry, etc.

Tributary - A stream or river flowing into a larger stream, river or lake. The New River and the Gauley River are tributaries of the Kanawha River.

Volume - A quantity, bulk, mass or amount. The amount of space occupied in three dimensions.

Water - A transparent, odorless, tasteless liquid compound of hydrogen and oxygen (H_2O) which occurs on the earth's surface as oceans, lakes, rivers, etc.

Water quality - A measurment of certain characteristics of water.

Watershed - All of the land area that drains directly or indirectly into a creek, river, lake or other body of water.

References

Amos William H. 1969. "Limnology." For more information contact the LaMotte Chemical Products Company, Education Products Division, P. O. Box 329, Chestertown, MD 21620.

Balcom, Nancy C. (ed.). 1991. "Mainstream," "Habitat Hunt," "Where the Water Falls" and "Little Limnologists" activities. *Virginia's State Parks: Your Backyard Classroom,* Chesapeake edition. For information contact the Virginia Department of Conservation and Recreation, Division of State Parks, 203 Governor St., Suite 306, Richmond, VA 23219.

Borror, Donald J. and Richard E. White. 1990. *A Field Guide to Insects of America North of Mexico.* Boston, MA: Houghton Mifflin Co.

Brown, Walker R., and Norman D. Anderson. 1971. *Earth Science — A Search for Understanding.* Philadelphia, PA: Lippencott Co.

Caduto, Michael J. 1985. *Pond and Brook, A Guide to Nature Study in Freshwater Environments.* Englewood Cliff, NJ: Prentice Hall, Inc.

Dean, Jim. 1978. "The Year the Floods Came," *Wildlife in North Carolina,* February. For more information contact NC Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Earley, Lawrence. 1990. "Taking a River's Pulse," *Wildlife in North Carolina.* August. For more information contact NC Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Everhart, Jerry (project director). 1986. *Project MOST.* For more information contact Pitt County Schools, 1717 West 5th St., Greenville, NC 27834.

Headstrom Richard. 1964. *Adventures with Freshwater Animals.* Mineola, NY: Dover Publications.

Izaak Walton League of America. "Save Our Streams." For more information contact the Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington ,VA 22209.

McCafferty, Patrick W. 1981. *Aquatic Entomology, The Fisherman's And Ecologist's Illustrated Guide to Insects and Their Relatives.* Illustrations by Arwin V. Provonsha. Boston, MA: Jones and Bartlett Inc.

McLane, A.J. 1965. *McClanes' Standard Fishing Encyclopedia and International Angling Guide.* Austin TX: Holt Rinehart and Winston Inc.

Mitchell, Mark and William Stapp. 1990. *Field Manual for Water Quality Monitoring. An Environmental Education Program for Schools.* Dexter, MI: Thomson-Shore Printers.

Montgomery County Public Schools. 1972. "Activities for Studying Streams," *Environmental Education Series,* Bulletin No. 247 A. For more information contact Montgomery County Public Schools, 850 Hungerford Drive, Rockville, MD 28050.

Montgomery County Public Schools. 1972. "Activities for Studying Ponds," *Environmental Education Series,* Bulletin No. 247 D. For more information contact Montgomery County Public Schools, 850 Hungerford Drive, Rockville, MD 28050.

National Aquarium in Baltimore. 1987. "In Hot Water?" *Living in Water: Aquatic Science Curriculum for Grades 4-6.* For more information contact the National Aquarium in Baltimore, 501 E. Pratt Street, Pier 3, Baltimore, MD 21202.

National Wildlife Federation. 1983. *Acid Rain — A Teacher's Guide.* For more information contact the National Wildlife Federation, 1400 16th St., N.W., Washington, DC 20036-2266.

National Wildlife Federation. 1987. "We Care About Clean Air," *National Wildlife Week Educators Guide*, March 15-21. For more information contact the National Wildlife Federation, 1400 16th St., N.W. Washington, DC 20036-2266.

National Wildlife Federation. 1990. "Pollution: Problems and Solutions," *Ranger Rick's Nature Scope.* For more information contact the National Wildlife Federation, 1400 16th St., N.W., Washington, DC 20036-2266.

National Wildlife Federation. 1990. "Earth Day Every Day — You Can Make a Difference," *Educator's Guide.* For more information contact the National Wildlife Federation, 1400 16th St., NW, Washington, DC 20036.

Needham, James and Paul Needham. 1962. *A Guide to The Study of Freshwater Biology.* Oakland, CA: Holden-Day Inc.

North Carolina Division of Parks and Recreation. 1993. *Duke Power State Park Environmental Education Learning Experience.* For More information contact Duke Power State Park, Rt. 2, Box 224-M, Troutman, NC 28166.

North Carolina Division of Parks and Recreation. 1993 *Eno River State Park Environmental Education Learning Experience.* For more information contact Eno River State Park, Rt. 2, Box 436 C, Durham, NC 27705.

North Carolina Division of Water Resources. 1991. "pH — What Does It Mean?" *Streamwatch News,* Issue #13, Feb. For more information contact North Carolina Division of Water Resources, PO Box 27687, Raleigh, NC 27611.

North Carolina Division of Water Resources. 1991. "Sediment: It's Only Dirt, Right?" *Streamwatch News,* Issue #15, Nov. For more information contact North Carolina Division of Water Resources, PO Box 27687, Raleigh, NC 27611.

North Carolina Wildlife Resources Commission. Dec. 1989. "Josh and the Fish Kills", *North Carolina WILD Notebook.* For more infor-mation contact the Division of Conservation and Education, North Carolina Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Page, Lawerence and Brooks M. Burr. 1991. *Freshwater Fishes.* Peterson Field Guide Series. Boston, MA: Houghton Mifflin Co.

Pfeiffer, C. Boyd and Mark Sosin. 1987. *Aquatic Resources Education Curriculum.* Dubuque, IA: Kendall/Hunt Publishing Co.

Quammen, David. 1985. *Natural Acts, A Sidelong View of Science and Nature.* New York, NY: Nick Lyons Books.

Reid, K. George and Herbert Zim. 1967. *Golden Guide, Pond Life.* New York, NY: Golden Press Inc.

Schoenbaum, J. Thomas. 1979. *The New River Controversy.* Winston Salem, NC: John F. Blair, Publlishing

Slattery, Britt E. 1991. "Wet'n'Wild," *WOW!: The Wonders of Wetlands: an Educator's Guide.* For more information contact Environmental Concern, Inc., P.O. Box P, St. Michaels, MD 21663.

Swan, Malcolm D. 1983. *Tips and Tricks in Outdoor Education —Approaches to Providing Children with Educational Experiences in the Outdoors.* Danville, IL: The Interstate Printers & Publishers, Inc.

Taylor, Mark. 1989. *Streamwalking With Kids, An Outing Leader's Guide.* Reprinted by North Carolina Wildlife Resources Commission. For more information contact the North Carolina Wildlife Resources Commission, 512 North Salisbury Street, Raleigh, NC 27604-1148.

Tennessee Valley Authority. 1986. *Groundwater: A Vital Resource, Student Activities.* For more information contact T.V.A., Office of Natural Resources and Economic Development, Environmental/Energy Education Program, Knoxville, TN 37902.

Tennessee Valley Authority. *Water Sampling Equipment.* For more information contact T.V.A., Office of Natural Resources and Economic Development, Environmental/Energy Education Program, Knoxville, TN 37902.

Tennessee Valley Authority. *Homemade Sampling Equipment.* For more information contact T.V.A., Office of Natural Resources and Economic Development, Environmental/ Energy Education Program, Knoxville, TN 37902.

Western Regional Environmental Education Council. 1987. *Aquatic Project WILD.* For information contact the North Carolina Wildlife Resources Commission, 512 North Salisbury St., Raleigh, NC 27604-1148.

Willoughby, L. G. 1976. *Freshwater Biology.* New York, NY: Pica Press.

Winborne, Ferne B. 1989. *A Guide to Streamwalking.* For more information contact the North Carolina Division of Water Resources, 512 North Salisbury Street, Raleigh, NC 27604-1148.

SCHEDULING WORKSHEET

For office use only:
Date request received _____ Request received by _____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____
(Note: A maximum of 30 participants is recommended.)

8) Number of chaperones _____
(Note: One adult for every 10 students is recommended.)

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)_____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____

12) Are parental permission forms required? _____ If yes, please use the Parental Permission form on page 8.2.

I, _____, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: New River State Park
P.O. Box 48
Jefferson, NC 28640

PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at **New River State Park**. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____
   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____
   _____

3. What part(s) did you find the least interesting and useful?_____
   _____

4. What can we do to improve the program(s)?_____
   _____
   _____

5. General comments _____
   _____
   _____
   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____
   If not, why? _____
   _____

Please return the completed form to park staff. Thank you.

New River State Park
P.O. Box 48
Jefferson, NC 28640

Notes